



Tanta University

Faculty Of Engineering

Electrical Power and Machines Department

1st Year (Electrical) 2012/2013 *(2nd Term)*

Electrical Circuits (2) *(EPM1203)*

Sheet (1)

Response of First-Order RL & RC Circuits

1) The switch in the circuit in the fig.1 has been closed for a Long time before opening at t=0.

Find :

a) $i_1(0^-)$ and. $i_2(0^-)$.
b) $i_1(0^+)$ and $i_2(0^+)$.
c) $i_1(t)$ for $t \geq 0$.
d) $i_2(t)$ for $t \geq 0^+$.
e) Explain why $i_2(0^-) \neq i_2(0^+)$

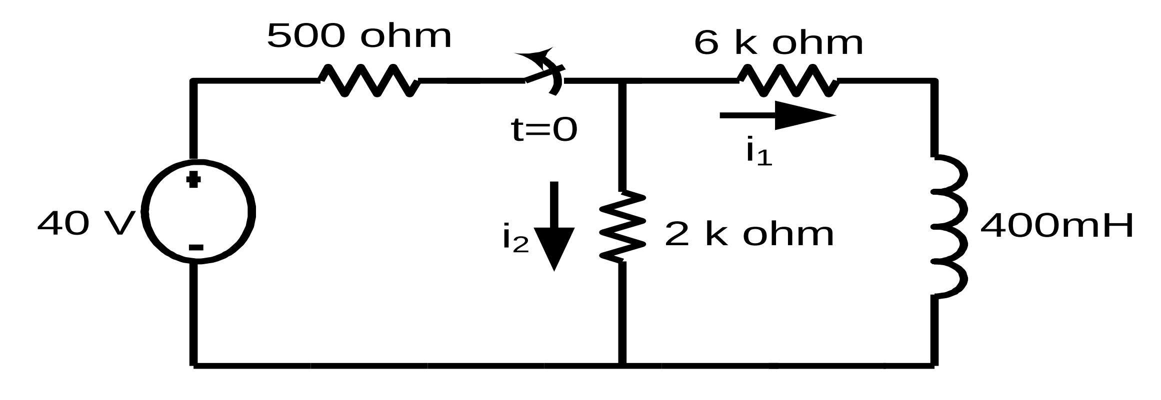


Fig.1

2) In the circuit shown in fig.2 the switch makes contact with position b just before breaking contact with position a. As already mentioned, this is known as a make–before – break switch and is designed so that the switch does not interrupt the current in an inductive circuit. The interval of time between "making" and "breaking" is assumed to be negligible. The switch has been in the position for a longtime. At t = 0 the switch is thrown from position a to position b.

a) Determine the initial current in the inductor.
b) Determine the time constant of the circuit for t > 0.
c) Find I, v_1, and v_2 for t≥ 0.
d) What percentage of the initial energy stored in the inductor is dissipated in the 45 Ω resistor 40 ms after the switch is thrown from position a to position b.

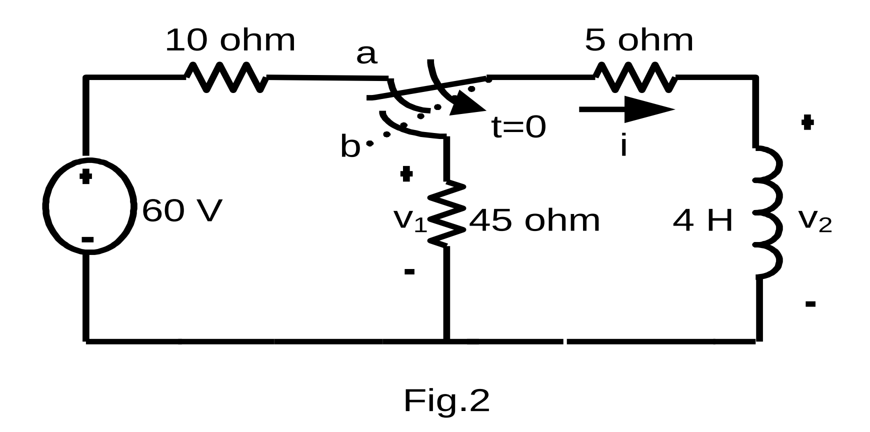


Fig.2

3) In the circuit in fig.3, the voltage and current expressions are
V= 400e^{-5t} V, t ≥ 0^{+} , I= 10e^{-5t}A, t≥ 0 ,

Find:
a) R.
b) ζ (in milliseconds).
c) L.
d) The initial energy stored in the inductor.
e) The time (in milliseconds) it takes to dissipate 80% of the initial stored energy.

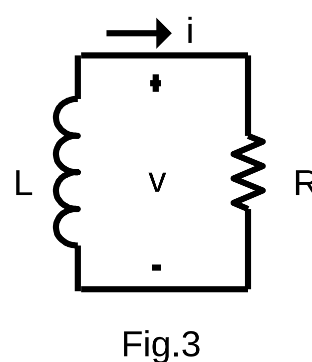


Fig.3

4) The switch in the circuit seen in fig.4 has been in position 1 for long time. At t = 0, the switch moves instantaneously to position 2. **Find** the value of R so that 1/5th of the initial energy stored in the 30 mH inductor is dissipated in R in 15 µs.

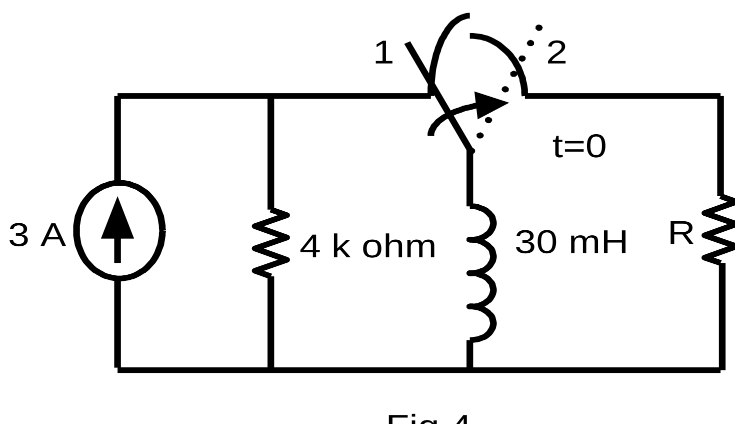


Fig.4

5) The switch in the circuit in fig.5 has been closed a long time. At t=0 it is opened .

Find : i_0(t) fort ≥ 0.

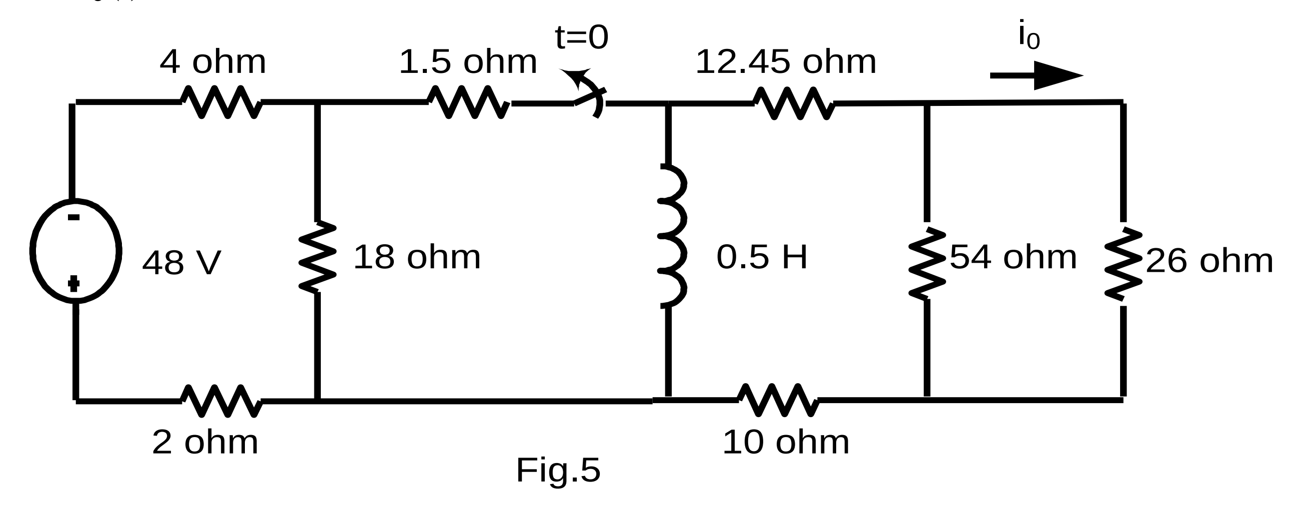


Fig.5

6) Assume that the switch in the circuit in the fig.5 has been open for one time constant. At this instant, **what** percentage of the total energy stored in the 0.5H inductor has been dissipated in the 54 Ω resistor?

7) The switch in the circuit in fig.6 has been in position 1 for a long time. At t=0, the switch moves instantaneously to position 2. **Find:** $\mathbf{v_o}$(t) for t ≥ 0

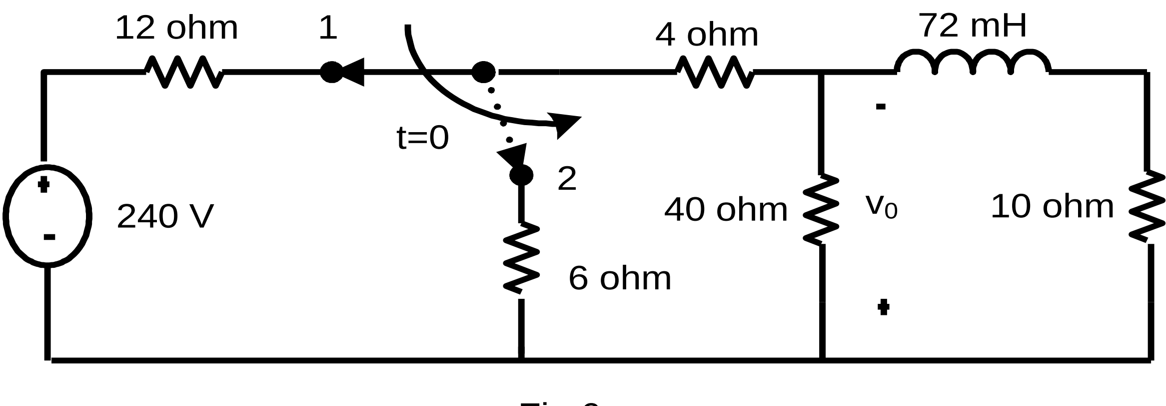


Fig.6

8) In the circuit in fig.7 the switch has been closed for a long time before opening at t =0.

Find :
a) The value of L so that v_o(t) equals 0.5 v_o (0^+) when t = 1ms.
b) The percentage of the stored energy that has been dissipated in the 10 Ω resistor when t = 1 ms.

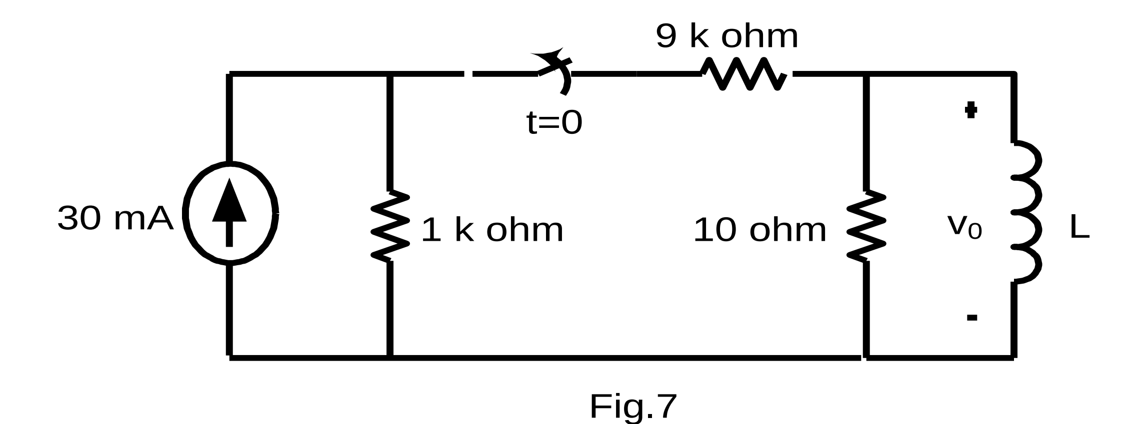


Fig.7

9) The two switches in the circuit seen in fig.8 are synchronized. The switches have been closed for a long time before opening at t = 0.

a) How many microseconds after the switches are open is the energy dissipated in the 4Ω resistor 10% of the initial energy stored in the 6 H inductor.
b) At the time calculated in (a),
what percentage of the total energy stored in the inductor has been dissipated ?

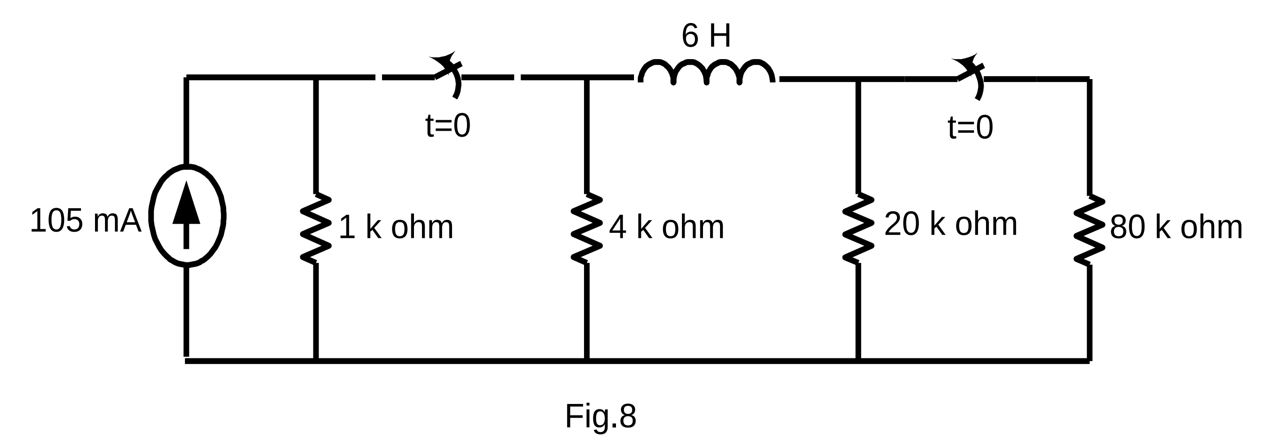


Fig.8

10) The switch in the circuit in fig. 9 has been in position a for a long time. At t = 0, the switch is thrown to position b.

a) Find i_0(t) for t≥ 0^+.
b) What percentage of the initial energy stored in the capacitor is dissipated in the 3 kΩ resistor 500 µs after the switch has been thrown?

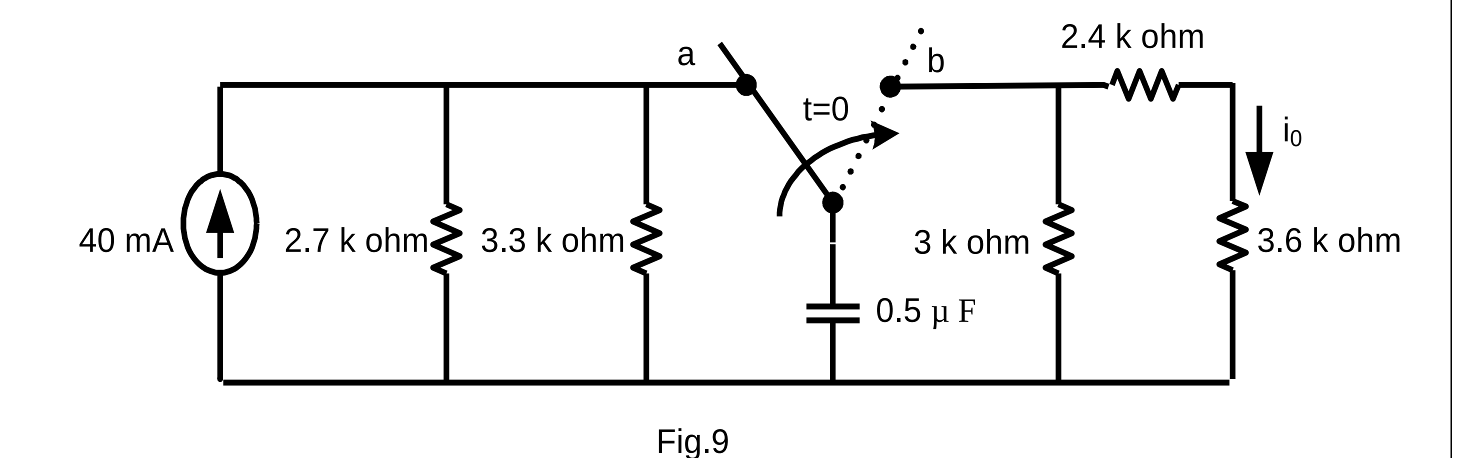


Fig.9

11) In the circuit in fig.10 the voltage and current expressions are:
V= $48e^{-25t}$ V, t ≥ 0, I = $12e^{-25t}$ mA, t ≥ 0^{+},

Find:
a) R
b) C.
c) ζ (in milliseconds).
d) The initial energy stored in the capacitor.
e) The amount of energy that has been dissipated in the resistor 60 ms after the voltage has begun to decay.

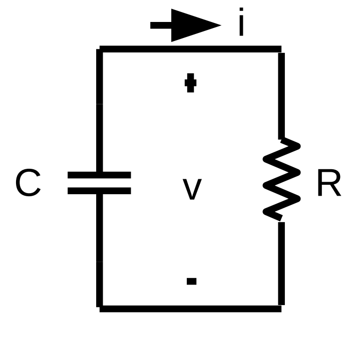


Fig.10

12) The switch in the circuit in fig.11 is closed at t = 0 after being open for a long time

Find :
a) i_1 (0^{-}) and i_2 (0^{-}).
b) $i_1(0^{+})$ and $i_2(0^{+})$.
c) i_1(t) for t ≥ 0.
d) i_2(t) for t≥ 0^{+}.
e) Explain why $i_2(0^{-})= i_2(0^{+})$.
f) Explain why $i_2(0^{-}) \neq i(0^{+})$

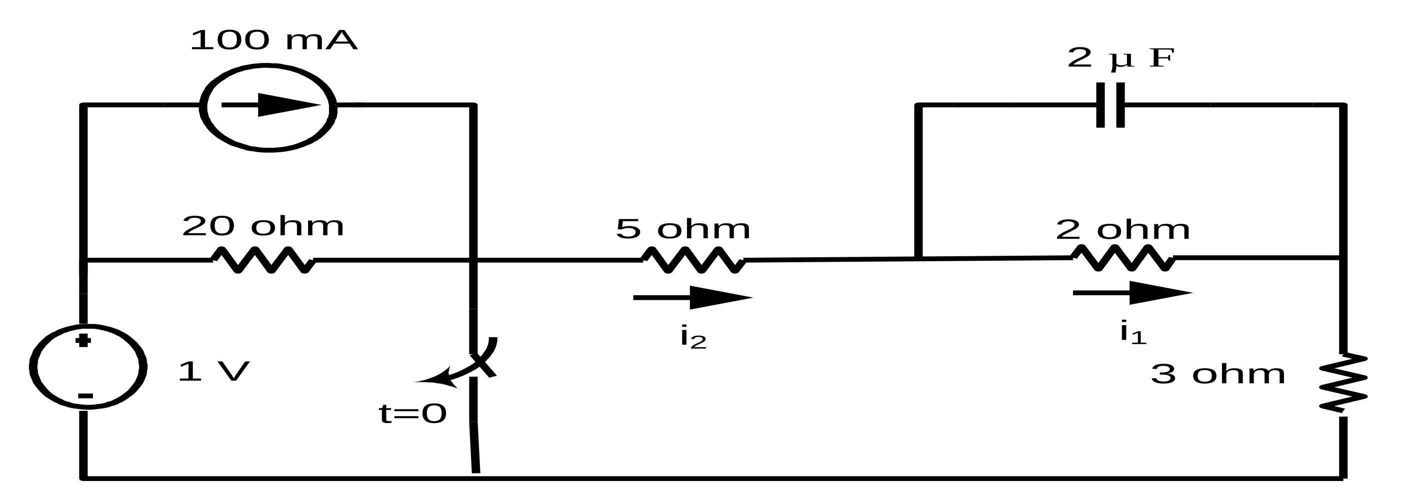


Fig.11

13) In the circuit shown in fig.12 both switches operate together; that is, they either open or close at the same time. The switches are closed a long time before opening at t = 0.

a) How many micro joules of energy have been dissipated in the12 k **Ω** resistor 12 ms after the switches open?

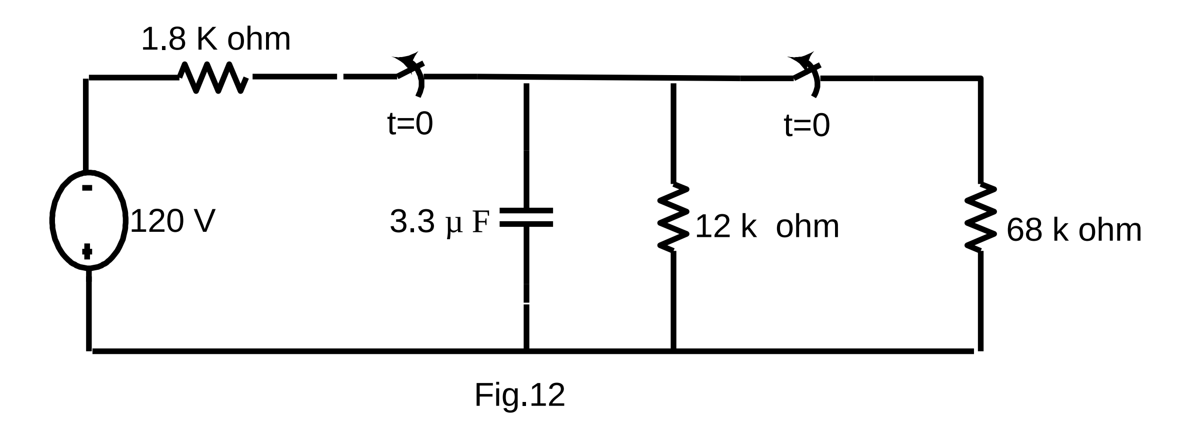


Fig.12

14) The switch in the circuit shown in fig.13 has been closed for a long time before opening at t=0.

Find:

a) The numerical expression for i_l(t) and v_0(t) for t ≥ 0.

b) The numerical values of v_l(0+) and v_0(0+). .

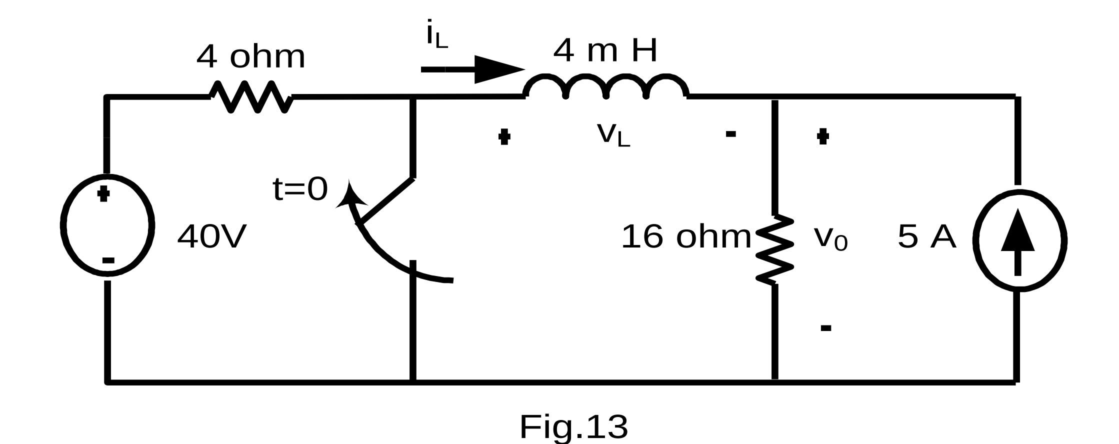


Fig.13

15) The switch in the circuit shown in fig.14 has been in position a for a long time. At t=0 ,the switch moves instantaneously to position b.

Find:

a) The numerical expression for i_0(t) when t ≥ 0.

b) The numerical expression for v_0(t) for t ≥ 0^+

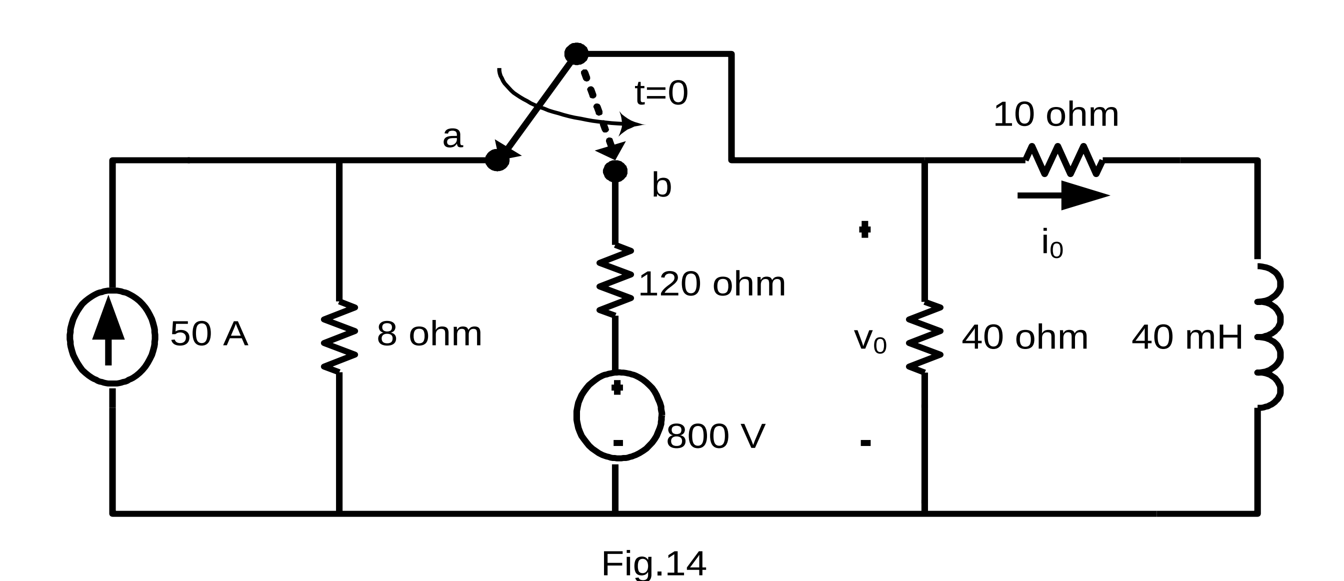


Fig.14

16) The switch in the circuit seen in fig.15 has been closed for a longtime. The switch opens at t = 0.

Find the numerical expression for i_0(t) and v_0(t) when t ≥ 0+.

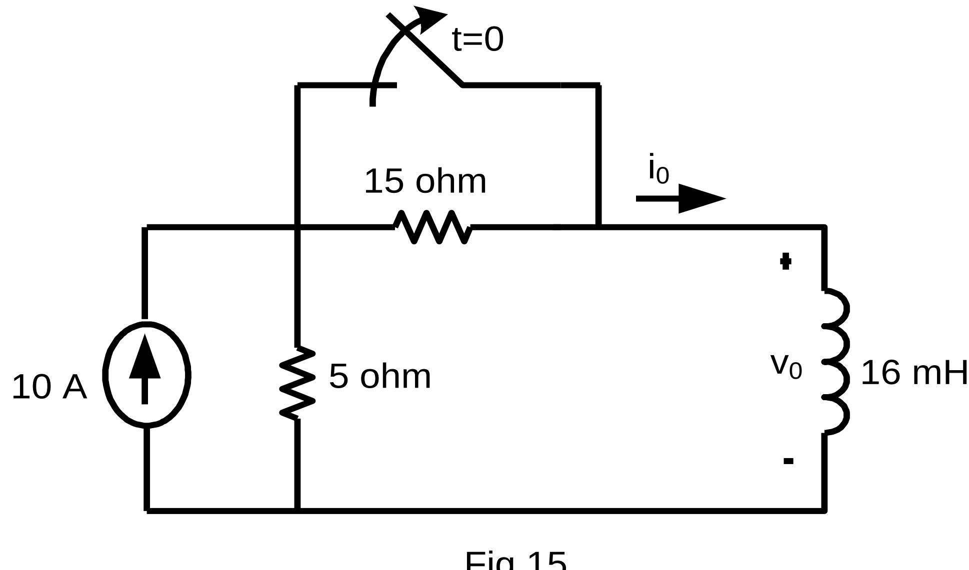
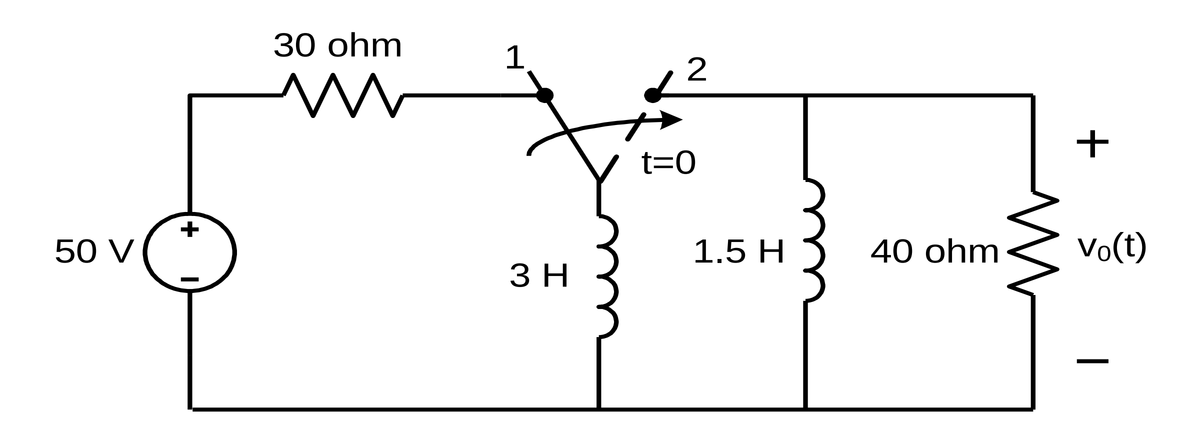


Fig.15

17) The switch in the circuit in Fig. P7.46 has been in position 1 for a long time. At t = 0 it moves instantaneously to position 2. How many milliseconds after the switch operates does v_o equal 100 V?

Find (in joules)**:**
a) The total energy dissipated in the 40 Ω resistor.
b) The energy trapped in the inductors.
c) The initial energy stored in the inductors.



18) The switch in the circuit in fig. 17 has been in position a for a long time and v_2= 0 V. At t = 0, the switch is thrown to position b .

Calculate:
a) i_o(t), v_1(t) and v_2(t) for t ≥ 0^+.
b) The energy stored in the capacitor at t = 0.
c) The energy trapped in the circuit and the total energy dissipated in the 25 k Ω resistor if the switch remains in position b indefinitely.

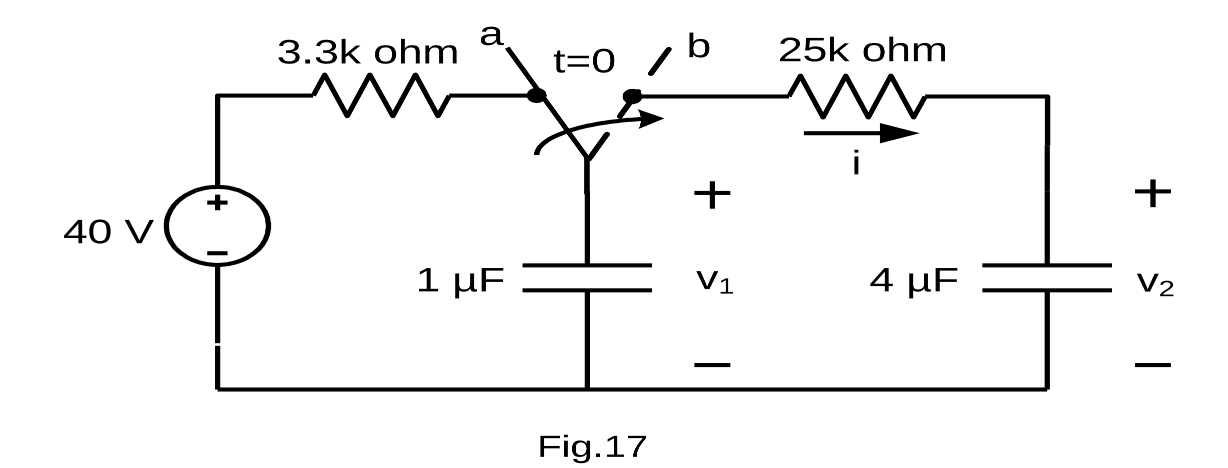


Fig.17

19) In the circuit in Fig. 19, switch A has been open and switch B has been closed for a long time. At t = 0, switch A closes. Five seconds after switch A closes, switch B opens. **Find**: i_l(t) for t ≥ 0.

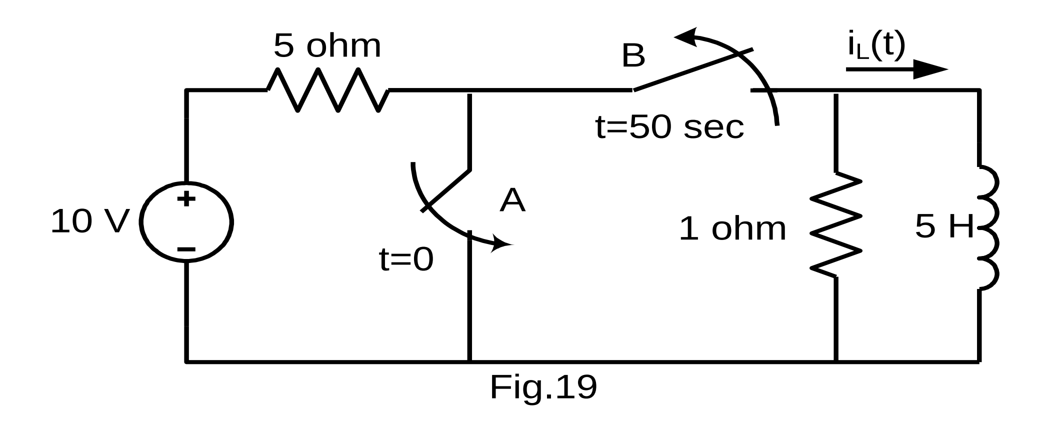


Fig.19

20) The switch in the circuit in Fig. 21 has been in position a for a long time. At = 0, it moves instantaneously to position b, where it remains for five seconds before moving instantaneously to position c. **Find**: v_c(t) for t ≥ 0.

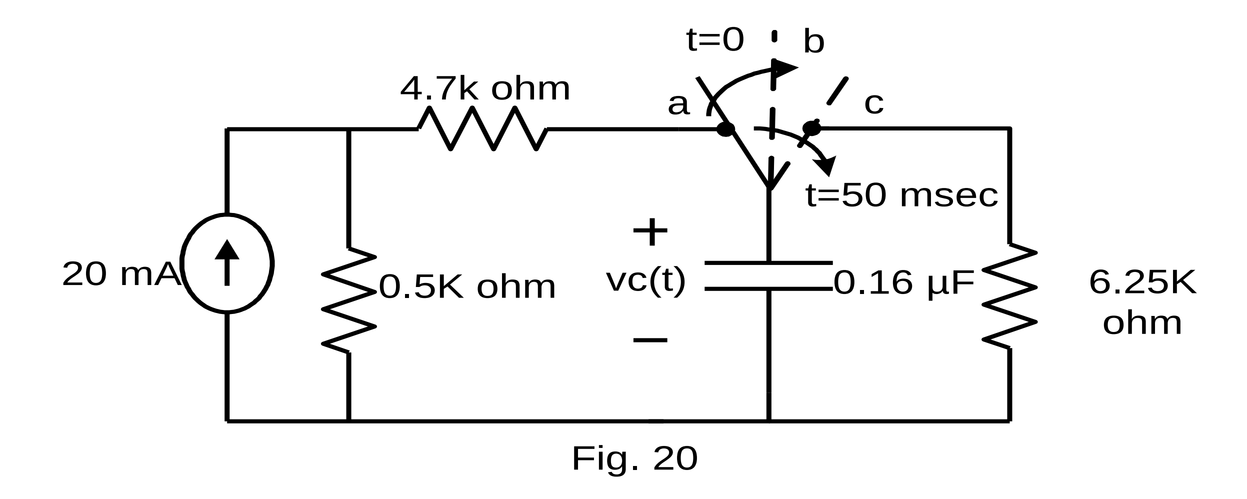


Fig. 20